# NEW QUANTUM NUMBER AND SELECTION RULES FOR CHIRAL DOUBLET BANDS AND CHIRAL WOBBLERS

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Spontaneous formation of handedness in rotating nuclei, known as nuclear chirality[1], and partial transfer of collective rotation to other principal axes from the axis having largest moment of inertia, known as wobbling motion[2], share common underlying physics, namely a stable triaxial deformation. The experimental evidences for nuclear chirality have been reported in several odd-odd[3] and odd-A[4] nuclei in the A $\sim$130 region as well as, recently, in the A$\sim$100 region[5]. On the other hand, wobbling motions have been observed in few odd-A Lu isotopes[6].

A model for a special configuration in odd-odd nuclei has been constructed in which a valence proton particle and a valence neutron hole in the same high-$j$ shell are coupled to a triaxial rotor with $\gamma = 90°$. Numerical results for the $\pi h_{11/2} \otimes \nu h_{11/2}^{-1}$ configuration exhibit a family of degenerate $\Delta I = 1$ bands for intermediate spin range. The obtained degeneracy is a manifestation of dynamical spontaneous formation of right- or left-handed system. In order to minimize the interaction energy with the triaxial mass distribution, angular momentum of the particle-like valence proton orients along the short axis, while that of the hole-like neutron aligns along the long axis. The core rotation favors the intermediate axis to minimize the rotational energy. As a result, three angular momenta self organize to couple mutually perpendicular leading to two system of opposite handedness or chirality. A quantum number obtained from the invariance of the model Hamiltonian, which characterizes states in the laboratory frame, has been given and the selection rule for electromagnetic transition probabilities in chiral bands has been derived in terms of this quantum number[7]. Furthermore, decomposition of the core rotation has shown that the ground state chiral pairs have the largest projection of the core rotation along the intermediate axis and successively less for the excited degenerate chiral pairs. It is numerically shown that these excited pairs have nearly the same intrinsic structure as the ground state pairs. Therefore, the present study indicates that the excited chiral pairs can be interpreted as wobbling excitations or chiral wobblers[8].

[1] S. Frauendorf, Rev. Mod. Phys. **73**, 463 (2001).
[2] A. Bohr and B. Mottelson, *Nuclear Structure Vol. II*, Benjamin, New York, 1980.
[3] K. Starosta *et al.*, Phys. Rev. Lett. **86**, 971 (2001).
[4] N. Zhu *et al.*, Phys. Rev. Lett. **91**, 132501 (2003).
[5] C. Vaman *et al.*, Phys. Rev. Lett. **92**, 032501 (2004).
[6] S. W. Ødegård *et al.*, Phys. Rev. Lett. **86**, 5866 (2001).
[7] T. Koike, K. Starosta, and I. Hamamoto (submitted to Phys. Rev. Lett.).
[8] T. Koike *et al.*, (to be submitted to Phys. Rev. C).